



## FY-DoS for multi-rotors control manual

### Installation & Operation      Firmware V2.0

#### Dear Customer:

Thank you for choosing DoS as your autopilot system. Please read this manual carefully before using the system to ensure proper use and operation.

The installation and use of this device require some skill and knowledge in flying remote controlled airplane model.

- If you are a complete beginner and have never flown one before, we do not recommend you install this device on your own.
- Please find assistance from an experienced RC pilot who may provide you with the basic knowledge required to use this device successfully.
- If you are already an experienced flyer, you will find the DoS installation to be easy and logical. Just follow this manual and you won't go wrong.

If you need any technical support you can send e-mail directly to: [service@feiyu-tech.com](mailto:service@feiyu-tech.com)

#### DoS module

DoS is an Attitude Flight Stabilization System (AFSS) and autopilot system. Now can be used for automated stabilization of fixed wing aircrafts, and after upgrade firmware can be used for other aircraft and equipment control (For more details of DoS, please refer to the latest firmware and the instructions).

DoS has integrated three-axis gyro, three-axis accelerometer, three axis magnetometer and barometric pressure sensor. DoS can accurately measure flight attitude, the earth azimuth and through the barometer to measure relative altitude. ***This manual mainly introduces DoS firmware for Multi-rotor flight system.***

The latest firmware for Multi-rotor flight system is V2.0 can realize the following functions: (We will continue updating new firmware to improve performance and update functions, please pay attention to the latest news FeiYu official website ([www.feiyudz.cn](http://www.feiyudz.cn)) posted.)

#### ● Attitude Stabilized Mode

DoS can auto stabilize the aircraft flight attitude in this mode, pitch and roll stick center position for 0° attitude, its endpoint is 45°, pitch and roll stick can linear control the flight attitude, maximum angular velocity is 150°/s. Yaw stick in the center position will lock current course, its endpoint corresponding maximum rotation rate 135° per second, yaw stick can linear control the aircraft rotation rate. Throttle stick direct control aircraft climb and decline, climbing and declining rate is directly related to the throttle.

#### ● Fixed Altitude Flight Mode

In this Mode, pitch, roll, yaw control method is the same as Attitude Stabilized Mode. DoS can auto control flight altitude. Climbing and descending rate is directly related to the throttle, when the throttle stick is in the center position, DoS auto locks the altitude, in maximum means climb rate is 3 m/s, in minimum means decline rate is 1.5 m/s. Throttle stick can linear control the aircraft climb and decline rate.

#### **Attention:**

Please as far as possible to maintain the current altitude when switch Attitude Stabilized Mode to Fixed altitude flight Mode, in order to lock the altitude throttle stick

**has to be in the center position.** To prevent the altitude sudden change caused by the throttle, you have to put throttle stick back to balance flight position, when switch off fixed altitude flight mode.

**1. DoS standard configuration:**

**Standard configuration**

- DoS control module \*1;
- RC receiver connecting wires \* 1;
- USB cable \*1;
- Velcro double sided tape \* 2;

**Optional accessory**

- DoS vibration absorbing mount \*1;
- GPS module \*1;
- Hornet OSD module;
- Data Radio;
- Remote Adaptor;

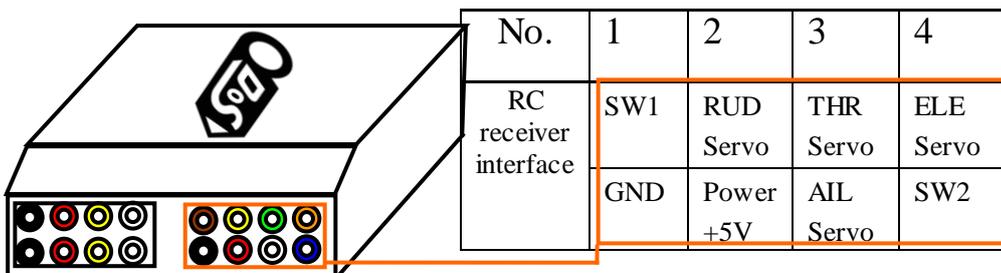
**2. Technical Specification:**

**DoS module**

Input voltage : 4.0 ~ 6.0 Volt;  
 Current : 50mA (5V);  
 Size : 47 x 30 x 11 mm;  
 Weight (excluding wires) : 25g;  
 Temperature range : -25 °C ~ +70 °C;  
 Control frequency : 400HZ  
 Maximum rate of rotation : ≤ 2000 °/s.

**3. Interface specifications:**

■ Remote receiver input interface

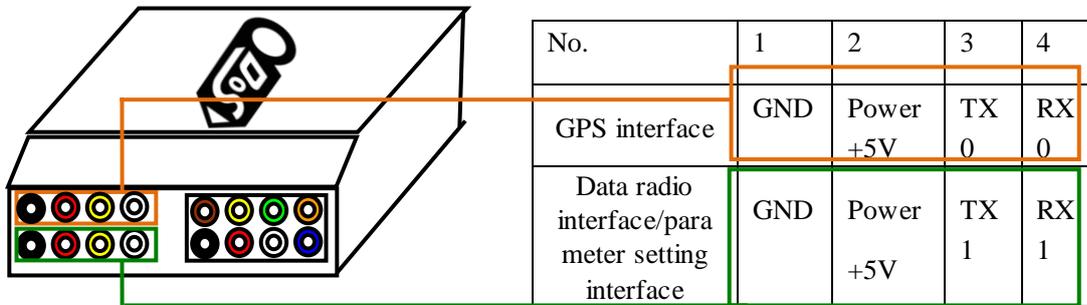


### SW1 default setting state

position	1	2	3
servo signal output	900 ~ 1200US	1200~1800US	1800~2100US
function	stabilized mode	stabilized mode	fixed altitude Mode

**Attention:** SW1 can be used to switch DoS flight modes by any 2 or 3-position switch. SW2 is unnecessary in firmware V2.0.

### ■ GPS and UART interface



### GPS module interface

The GPS pin interface consist of: GND, +5V , RX0. The characteristics are:  
 Baud rate: 38400  
 Data bits: 8  
 Stop Bits: 1  
 Parity: None  
 Interface Features: TTL level

This port is use for GPS Receiver. The GPS data protocol is standard NEMA0183.

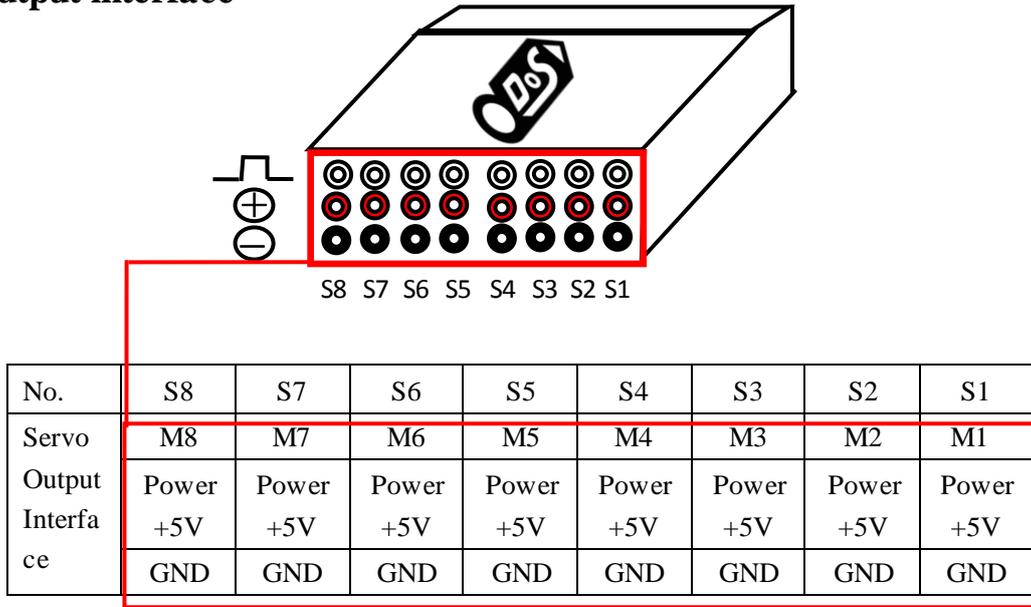
**Attention:** FY-DoS firmware V2.0 has no GPS navigation function ,so the GPS interface is not used.

### Data Radio interface

The UART pin interfaces consist of: GND, power 5V , TX1, RX1.  
 The characteristics as follows:  
 Baud Rate: 19200  
 Data bits: 8  
 Stop Bits: 1  
 Parity: None  
 Interface Features: TTL level

This pin interfaces connects to the Data Radio, PC computer serial port or OSD module. You can set DoS control parameters and upgrade DoS firmware through this interface. For the firmware upgrade, please refer to the firmware update operation manul.

■ ESC output interface



DoS's S1 ~ S8 ports are connected separately to ESC M1 ~ M8. Typically 1020us is lower limit, 1520us is neutral and 2020us is upper limit, frequency is 400Hz.

4. Power Supply:

- DoS input voltage is 4.0 ~ 6.0 V, you can use a stabilized voltage supply ,or directly use ESC's +5 V power supply, most of the ESC power supply can meet the requirements;
- DoS and the RC receiver use the same power supply via the RC receiver connection wiring.
- **VERY IMPORTANT:** Only one BEC power source should be used. If all four ESCs have internal BEC, choose only one to supply power. Disconnect the red wire (positive) of the other ESCs, but reserve the GND and Signal wirings.

5. Indicator light instruction:

NO.	operating mode	LED
1	stabilized mode	● Single flash
2	fixed altitude mode	● ● Continuous Double flash each loop
3	Gyro needs Reset or is moving	● ● ● ● ..... Red light continuous flash
4	During the gyro reset	○ Flash white light for almost one second
5	too much vibration	●●●●● red light stay on solid

6. Vibration damping installation:

**Damping installation is the key for DOS to play multi-rotor aircraft flight performance well. Otherwise the aircraft can't keep balance, may cause roll or pitch or other abnormal conditions.**

We recommed using suspending damping installation, especially use DoS vibration absorbing mount which product by FeiYu Tech.(You can find purchase method from FeiYu official website: [www.feiyudz.cn](http://www.feiyudz.cn) )

Installation process as follows:(You need a allen driver)



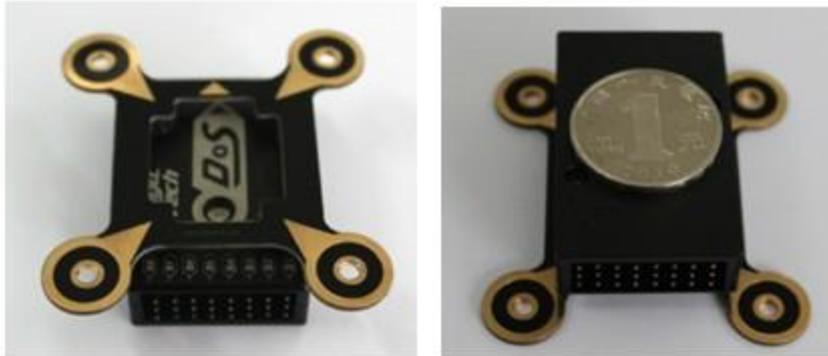
1.Use screws to install the four support columns on the baseboard;



2.Stick the solid foam pads (dampers) to the cover board four interior Angle position;



3. Stick the cover board to the DoS upper surface (LOGO character surface); you can appropriately increase DOS module weight to improve the damping effect, you can stick copper sheet or other sheet metal which cannot be magnetized on the bottom of the DOS (Otherwise the magnetized sheet metal will disturb the internal magnetic field sensors). If cannot then a coin maybe also OK as the current firmware version without GPS point hovering function the disturb is not so obvious.



4. Use screws to fix the cover board to the four support columns;



5. Stick the circular ring foam pads (dampers) to the four rounded corners on the baseboard vibration absorbing mount. Then fix it as far as possible to the position of barycentre on aircraft



## 7. RC receiver connection:

RC receiver and DoS connection wires is included in the DoS product. **Attention: the wires is arranged by the colors.**



- a) DoS requires a minimum of 6-channel RC receiver.
- b) 4 Receiver channels are used for aileron (channel 1), elevator (channel 2) , throttle (channel 3) and rudder (channel 4) signal output. Connect these 4 receiver output signals to the DoS with the supplied wires (pay attention to the color of each channel ).
- c) a free Receiver channels are required to control the DoS Flight Modes (a 3-position switch ,”SW1”).
- d)the other 3-position switch(SW2) is not used in firmware V2.0,so you do not need to connect.

Wire color	Receive channel	
White (bundled with red & black)	aileron	Channel 1
orange	elevator	Channel 2
green	throttle	Channel 3
yellow	rudder	Channel 4
brown	SW 1 Any free channel controlled by A 3-way switch or dial knob	Channel 5
blue	SW 2(not used) Any free channel controlled by A 3-way switch or dial knob	Channel 6

Attention:RC mode Setting of your controller has to be fixed wing model, and every channels’ maximum and minimum value to be the default value (100%), all the sticks trim to 0, also cancel all the curve set .

### 8. Motor start-up instruction:

**Start Motor:** When using multi-rotor firmware, pushing throttle stick before takeoff will not start motors. You have to execute Combination Stick Commands (CSC) in stabilized mode(**Can not in Fixed altitude flight Mode**) to start motors.

**Meet the following conditions:**

- Put Throttle stick to the lowest position
- Put Aileron stick to any endpoint position
- Put Elevator stick to any endpoint position
- Put Rudder stick to any endpoint position

Combination Stick Commands only need to execute for the first time power on and take off , the purpose is to prevent motor from wrong start, after execute Combination Stick Commands the motor will run at Idle Speed, now the throttle stick is at minimum position, at this time if you want to stop the motor running, you need to push throttle stick to idle speed above, and then put it to the minimum position, idle speed value default is 1170 us, the throttle stick below 20%. Take off again you do't need to the execute Combination Stick Commands when you (If you do not have power off and power on).

### 9. Gyroscope Reset:

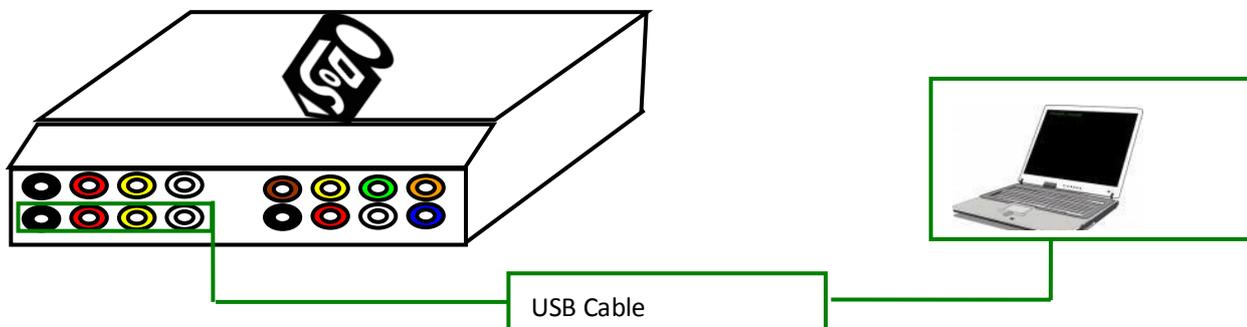
The Red LED flashes continuously even when the DoS remains stationary, that means you need to do the Gyro reset. The Gyro reset must be done before the Combination Stick Commands, after execute Combination Stick Commands you can not do the Gyro reset.

#### Initialization / Reset Process:

1. Power on DOS and keep stationary.
2. Switch to stabilized mode.
3. On SW1, switch stabilized mode to fixed altitude mode 6 times, time interval has to be less than 3 seconds as follows:  
 stabilized mode → fixed altitude mode → stabilized mode → fixed altitude mode  
 → stabilized mode → fixed altitude mode → stabilized mode → fixed altitude mode  
 → stabilized mode → fixed altitude mode → stabilized mode → fixed altitude mode.
4. DoS indicator will turn white about one second.
5. After white LED turns off, the re-setting / initialization is completed.

### 10. DoS Setting Software and installation and debugging instructions:

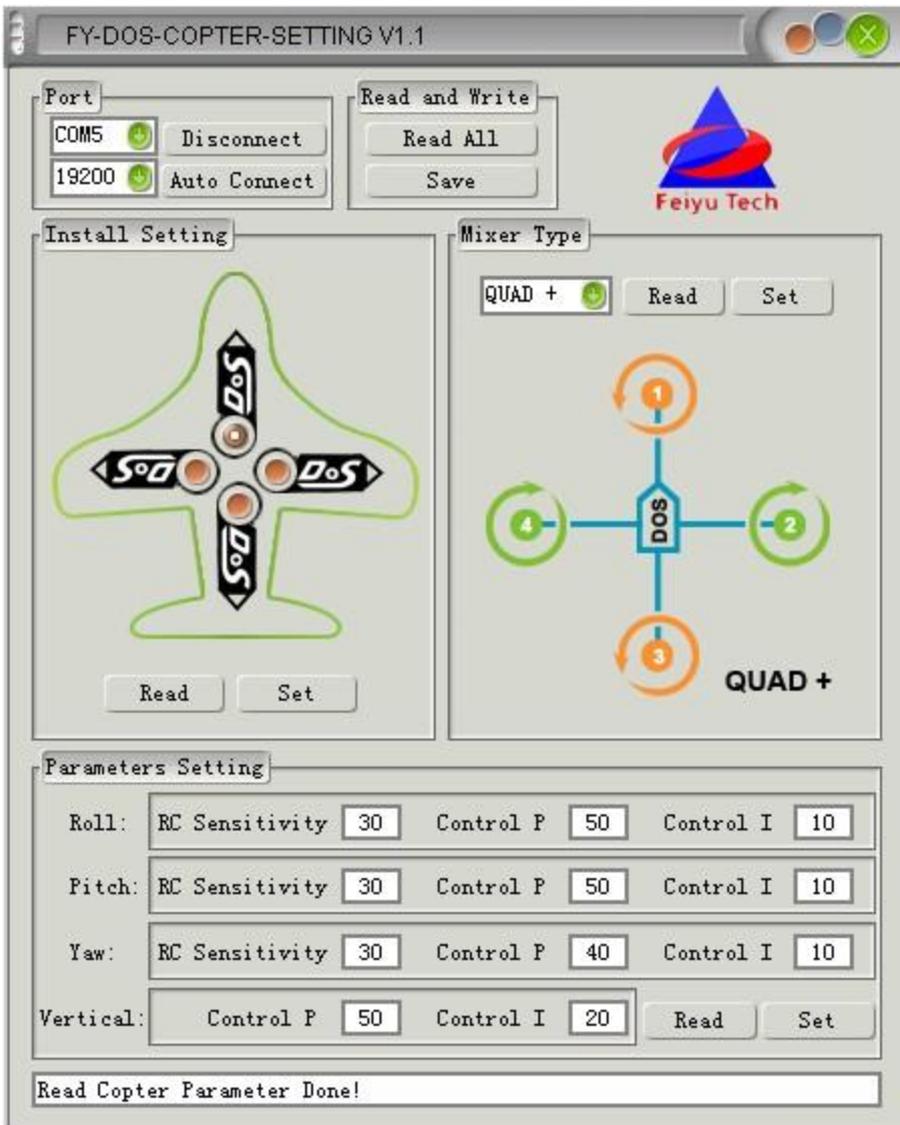
#### connection mode:



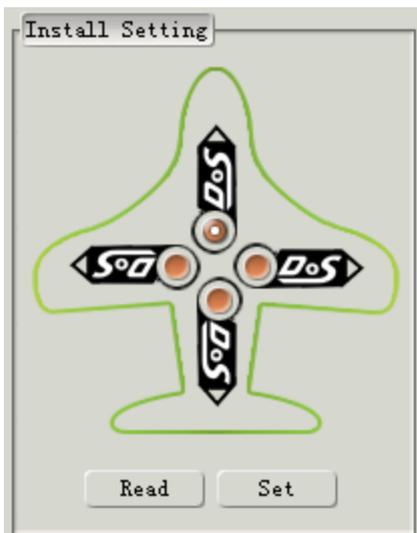
First need install USB-TTL device driver, you can download it form our website:

[www.feiyudz.cn](http://www.feiyudz.cn)

Software Interface Description:( **Parameter in the following picture is default parameter**)



● **Install Setting:**



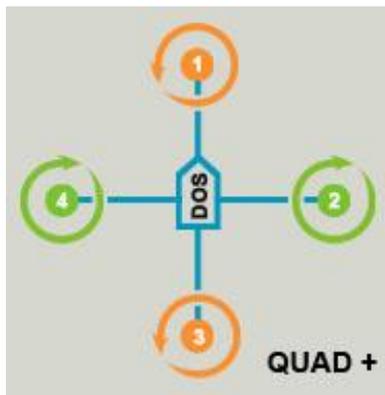
DoS supports four install directions. The LOGO must be installed facing up. DoS has an arrow printed on the topface. Normally orientate the arrow towards the head of the craft.

If adjust the installation direction, you have to set it via the setting software, otherwise will cause the aircraft abnormal condition.

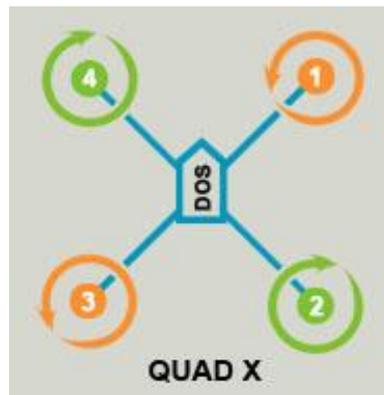
● **Motor Mixer**

The following pictures display the rotation direction and serial number of each motor, each ESC should be connected to the DoS S1 - S8 interface. Pay attention that once you choosed the control type, the corresponding position motor rotate direction have to be completely the same as the picture. (If the motor rotate direction is not correct then exchange any two of the three connect wires between ESC and motor to change the motor rotate direction.)

**DoS support the following types of multi-rotors:**



Quadcopter +



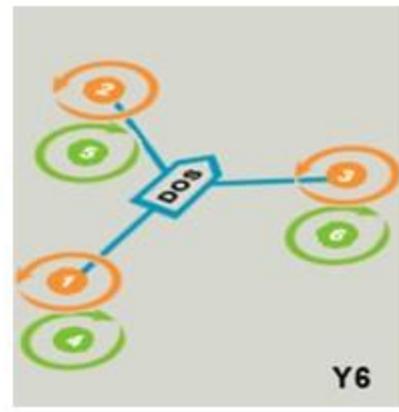
Quadcopter X



Hexacopter +



Hexacopter X



Y6



Octocopter +



Octocopter X

## ● Control parameters adjustment

Parameters Setting						
Roll:	RC Sensitivity	<input type="text" value="30"/>	Control P	<input type="text" value="50"/>	Control I	<input type="text" value="10"/>
Pitch:	RC Sensitivity	<input type="text" value="30"/>	Control P	<input type="text" value="50"/>	Control I	<input type="text" value="10"/>
Yaw:	RC Sensitivity	<input type="text" value="30"/>	Control P	<input type="text" value="40"/>	Control I	<input type="text" value="10"/>
Vertical:			Control P	<input type="text" value="50"/>	Control I	<input type="text" value="20"/>
					<input type="button" value="Read"/>	<input type="button" value="Set"/>

## ● RC Sensitivity

RC Sensitivity determine the reaction speed of attitude from command stick, the bigger the value the quicker the reaction. Increase it for sharper and quicker leveling action after command stick released. Unstable shaking flying and the control feeling will be stiffness and rigid if the value is too high; and sluggish leveling action and slow braking if too small.

## ● Control Gain

Control gain use for stabilizing the flight attitude. To the gains of Pitch and Roll, if you release the Pitch or Roll stick after command stick, multi-rotor should be back to hovering state.

**Control P:** If the reaction of multi-rotor in this procedure is too soft (large delay), please increase the basic gain slowly (10%-15% each time) until vibration emerges after you release the stick. Then decrease the gain a little until vibration just disappears. Now the gain is perfect.

**Control I:** This value generally do not need to adjust

## ● Course control gain adjustment

The way of tuning the Yaw gain is the same as the way of adjusting the Tail Gyro. If you want fast stick reaction speed, increase the gain, otherwise decrease the gain. However, the spin of multi-rotor is produced by the counter torque force, and the magnitude of which is limited. Therefore, large gain will not produce tail vibration like helicopter, but severe reaction at the start or stop of motors, which will affect the stabilization of the other directions.

## ● Vertical control Gain

Vertical control Gain is used for fixed altitude flight Mode.

**Control P:** You use two methods to judge if the Vertical gain is good enough: 1) The multi-rotor can lock the altitude when the throttle stick is at center position; 2) The change of altitude is small during the flight along a route. You can increase the gain slowly (10% each time) until the vibration emerges along the vertical direction or the reaction of throttle stick is too sensitive, then decrease 20% of the gain. Now it is a suitable Vertical gain.

**Control I:** This value generally do not need to adjust.

**Note:** We reserve the right to change this manual at any time! And the newest edition will be shown on our website.

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